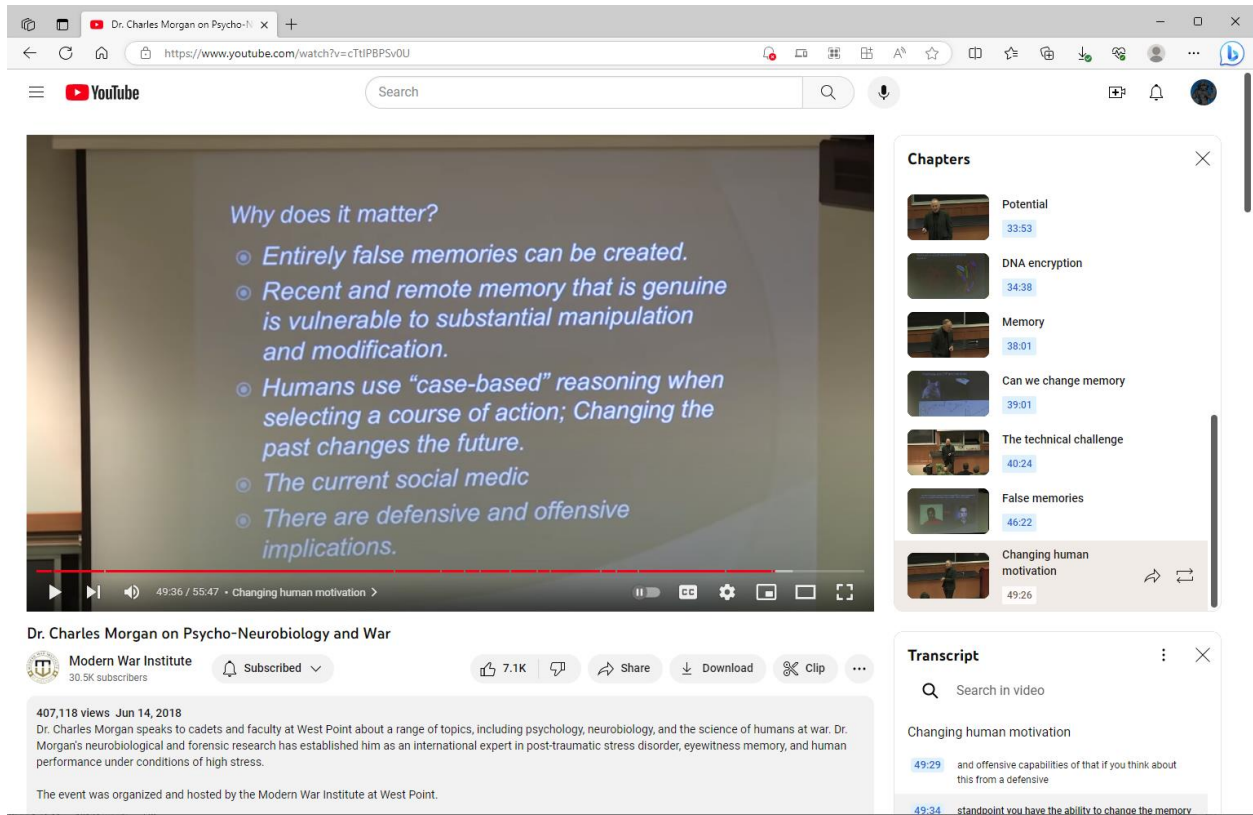


# Dr. Charles Morgan on Psycho-Neurobiology and War

(June 14, 2018)



**Why does it matter?**

- Entirely false memories can be created.
- Recent and remote memory that is genuine is vulnerable to substantial manipulation and modification.
- Humans use “case-based” reasoning when selecting a course of action; Changing the past changes the future.
- The current social medic
- There are defensive and offensive implications.

**Chapters**

- Potential 33:53
- DNA encryption 34:38
- Memory 38:01
- Can we change memory 39:01
- The technical challenge 40:24
- False memories 46:22
- Changing human motivation 49:26

**Transcript**

Changing human motivation

49:29 and offensive capabilities of that if you think about this from a defensive

49:34 standpoint you have the ability to change the memory

## Description Section:

Dr. Charles Morgan speaks to cadets and faculty at West Point about a range of topics, including psychology, neurobiology, and the science of humans at war. Dr. Morgan's neurobiological and forensic research has established him as an international expert in post-traumatic stress disorder, eyewitness memory, and human performance under conditions of high stress.

The event was organized and hosted by the Modern War Institute at West Point.

<https://www.youtube.com/watch?v=cTtIPBPSv0U>

## Transcript (auto generated)

0:12

I know you guys me through that or today we have dr. teleporting to talk to

0:18

us about neuroscience and psychology and

0:24

the whole whole gamut of things right now he is a professor of national security studies at the University of

0:29

New Haven this focus is teaching national security studies domestic and

0:35

international intelligence analysis and issues in deception dr. Morgan is

0:40

developing a concentration in the human aspects intelligence analysis and say psychological operations arenas that are

0:47

relevant to the ability to me he has a pretty robust background with military folks doing research at sere school

0:53

helping with selection processes for special operation forces done for Bragg

0:59

so thank you it's nice to be here

State

1:05

actually was an AVI it wasn't army but I've done more work with the army to think over all these years than I ever did with the Navy so

1:11

so I would like to talk to you a little bit about state is something I was asked to do in 2010 and 2011 I was getting

1:20

ready to leave over the CIA where I'd worked for a number of years and the intelligence Science Board said could

1:26

you give us a brief what's instant what's in store for us in the future I was like I don't know predicting futures

1:32

really hard so I told my boss at the time I said well I think the best I'll do is make an estimate over what I think

1:38

is going to happen in the next five years given certain technologies that were being developed at the time and

1:43

this is a bit of an extension of that I presented to the SSG and it was some

1:49

information I think some people didn't know and I think the it's good for people to be aware of what's going on out there

1:54

the the one thing that makes predicting a little bit of the future easier when you look at biomedical science is that

2:00

labs are working fairly systematically with overtly stated goals so if you

2:06

think about it science is not really done in a haphazard way it takes time preparation you have to test multiple

2:12

hypotheses develop techniques so it is not really rocket science to look at a

2:17

lab and say this is where they're going and here are probably two of the Achilles heel points in the design but

2:24

if they surmount those they will probably achieve what they say they want do so that's a little bit of what this

2:30

is about I was going to give you my thoughts on mind body and beyond Jean

2:35

slicing the doctor vent nurse work DNA encryption and something about memory

2:42

that the past is not what it used to be what I'd like you to consider for a

2:48

minute is that one of the things that most people have a hard time understanding is that there is a

2:54

difference between our mind and our body your personal experience is usually of an integrated operating system since the

3:02

time you were little however there has been a plan in many labs to figure out how do we help people whose bodies don't

3:09

work in the way that they want them to do who have neurologic defects could you start the first video so as a way of

3:17

surmounting that people are experimenting five or six years ago as early as 2008 with whether or not you

3:26

can do a brain robotic interface I don't know if there's a volume for that with

3:32

our monkeys as they go through and try to learn how to use this robot

3:38

so they're using brain signals so signals from their motor cortex that we

3:44

pull out of wires into our systems and our computers then decode what it is

3:50

that that the monkey is intending to do and drive the end point of this arm

3:55

forward and backward and around through space the monkeys have brain control

4:01

over this robotic arm to move it forward and grab a piece of fruit as is presented and then bring it back to

4:06

their mouth to feed them self incredible

4:12

as it may seem these monkeys learn to feed themselves with a robot arm that was being directly controlled by their

4:19

brains as if it was simply part of them this is a biofeedback closed-loop kind

4:25

of experiment and that there's an automatic almost an automatic learning that's going on where we're

4:31

communicating with thee so essentially when you're little and you're growing up

Learning

4:37

and you're learning how to work your appendages you are making good motor neuron connections and inhibitory

4:43

connections and what they're able to do back in 2008 with a primate is have it

4:48

learn through trial and error that by thinking it can move a robotic arm and feed itself it didn't take too long for

4:56

the neural interface issues to be resolved once people figured out you could implant electrodes on brain tissue

5:02

and then take a biological signal and turn it into an electrical signal and amplify it it took a little while for

5:09

the monkeys to figure out how to do it early on they would give it a little joystick so it was like playing a video

5:15

game and pretty soon the monkeys actually there's a chimp that's stunted as well she figured out she just didn't

5:22

need to use the little joystick and could just think about it and then the arm would move and the monkey would

5:28

began to experiment and would think about where it wanted the arm to go so it's learning I have a new appendage the

5:35

same is true in people you can see just four years later we see it being done in

5:40

humans and start that for me please with people who have neurologic injury

5:48

and can't use their limbs

5:53

I don't know if it'll play um yeah try and hover over the screen I think here

6:02

we go drag it down there you go perfect

6:08

yeah it's right my life has changed dramatically since the accident as of

6:14

right now there's nothing to cure paralysis besides maybe a miracle the first thing I'll do if I get my arms

6:20

back I would hug my daughter be really nice to scoop something up on a spoon

6:26

and feed myself yeah this is gonna go beyond spinal cord if this works this is gonna go ms this has gotta go stroke

6:31

this is huge this is millions and millions and millions of people I'm

6:40

pretty much broken from the neck down I guess you could say the only thing that I have left that is untouched is my

6:47

brain and obviously I'm able to use it very good I'll be able to do this and do that you know no memory loss no nothing

6:54

so I opted for an experimental surgery to go at the one thing that I still have

7:00

what we try to do is put a a grid in place that's capable of recording

7:05

signals from the brain so when you think when you think I want to move there's actually electrical impulses in the

7:11

brain we want to be able to record those electrical impulses and then decode what what the electrical impulses mean and

7:18

use that to control an object or an arm people have thought for a long time that

7:23

we might be able to tap into the brain but it's only recently that we've gotten closer and closer there's some great

7:29

work going on here at the University of Pittsburgh by a gentleman named Andy Schwartz and Andy has shown that he can

7:36

get a monkey to control a robotic arm with an amazing degree of freedom by

7:41

thoughts we've developed technology where we can implant an array of electrodes micro electrodes in the

7:47

cerebral cortex of monkeys and we can record activity from many neurons in the

7:53

brain simultaneously and from that signal we can extract the monkeys intention to move its arm and now that

8:00

we have that we can have intercept that signal and use it instead of moving the monkey's own arm

8:07

to use it to move a prosthetic on what it takes two people is a large team so

8:16

we've basically been somewhat isolated in our laboratory working on monkeys proving the technology just making

8:23

discoveries validating the technology developing new ways of doing this and what we've been able to do recently is

8:29

pass a lot of this knowledge that we've gained to clinical colleagues they came

8:36

to the laboratory learned a lot of what we're doing and then took it back to the clinic and developed the technology is

8:43

appropriate for humans two days after

9:14

surgery we put me in and started to basically train my brain train the

9:20

computer to my brain the way I'm thinking the computer doesn't know up-down left-right it just knows the signals that I'm thinking for a first

9:27

couple days it was just what's up what's down how I do it is I look at the ball

9:33

at the top and through my peripheral vision I see the ball that's moving so

9:38

I'm focusing on the target and almost with my peripheral if I want to go up I'm with my mental eyes or whatever you

9:46

want to call it lifting up trying to get that ball to go up or trying to get to go down so I'm focusing on the target

9:52

while watching the moving ball with my bro reel it's like a one player video

9:57

game I'm trying to be my own score because there is a score you know there's a certain percentage it's at a sixth you know each time I do it it's

10:04

out of 16 bawls if you want to say and a wonder

10:10

that number it's 13 I want the 14 I want the 15 and so it's just a challenge to

10:15

myself one thing I found out that if I focus too hard it doesn't work right it

10:21

has to be very natural that's pretty good yeah not too bad we're making such

10:26

ground on this every single day every other day we're just going leaps and bounds and knowing that we're doing that

10:33

if I had another week or two weeks or month where would we be that we'd be blunt mean we've already done the stuff

10:40

that's unprecedented you know I've been I've been doing stuff I've been told that with the 3d cursor which what

10:46

people have been doing it for a year two years that they haven't got the type of

10:52

control and percentages that I've gotten in a day the highway was 45 minutes ago

11:04

I got to use the robotic arm for the first time and

11:10

we got to reach out touch some over the first time in seven years so what you

11:17

see is people struggled with how to get the electrodes on the surface of the brain how to do the brain learning the

11:22

computer algorithms have improved this is by trial and errors it begins to recognize what the subjects brain is

11:28

doing but after that if you look at that as a scientific development in medicine you can quickly see the possibilities

11:35

that emerge I they're playing with motor function and linking it to thought so

11:41

the next step really when you think about it was to simultaneously try it with another another non-human animal

11:49

and find out if she could run a robot on the other side of the planet and the

11:55

essence of this experiment is at first she had to walk on the treadmill to keep the robot walking that she could observe

12:01

on a computer screen and then she just stopped walking and it would run the robot in Japan so you can have a brain

12:07

here in the United States plugged in running a robotic device a mechanical

12:13

device via the internet somewhere else in the world so that was pretty cool it also has some funny implications if you

12:20

see now where do you imagine this going when you think of it as an offensive or defensive opportunity with respect to

12:26

the intelligence community the natural segue then would be if I can send motor function from a brain to a mechanical

12:33

arm is it possible to send motor functions from one human to another

12:39

human so I call it the possession experiment that one just the hover the

12:53

there you go there for our weekly tech

13:01

report now do you know the phrase brain power well it turns out that scientists at the University of Washington are

13:08

trying to hone that power and transmit it to another brain researchers call it

13:13

direct brain to brain communication and they do it by passing a signal from one mind to the next using the Internet

13:20

nonetheless so does it sound a little sci-fi Star Trek mind-meld Jedi mind-trick inception s to you well it

13:27

did to me too so I brought one of the researchers onto the show to tell me how it works dr. Andrea Stokoe is an

13:34

assistant research professor at the university of washington and he told me why this concept is not as weird as it

13:40

sounds it's not so science fiction we use currently resistant technologies to

13:46

read the brain patterns in a person and to transmit them to a different person

13:53

and we can only do it with very simple impulses right now like motor commands

13:58

to control the hand for instance so it's not that science fiction we was telling

14:03

me possible years ago is dead that we were the first to try sure so can you go into a little bit more detail about how

14:10

specifically it works what you need from the person and also what you need from wireless internet to make it come

14:15

together yes well that's like this a person is sitting on a chair and we call

14:22

this person the first brain or the sender and is connected to an EEG cap the AG cap detects electrical activity

14:28

all around the brain and he's capable recognizing when the brain patterns are doors that a person produces when he's

14:35

trying to move the right hand I was thinking about moving the right hand these very bodies are interpreted by a computer that controls a second computer

14:42

is connected over the Internet and the second computer action controls stimulating call the producer magnetic

14:49

field and is the magnetic field that is eventually directed over the head in such a way as to reproduce the

14:56

particular command in a selected part of the brain in this case the part of the brain that controls their I can the

15:02

wireless connection enters only in their communication between the two computers the two computers can be in the same

15:08

room and connected physically or they can be in any part of the world and talking to each other to the internet so

15:15

I won't you can watch the video but essentially what's happening is when one person is playing the video game they're

15:22

not using their hands they're simply looking at targets what's going on in the other room is a transcranial

15:27

magnetic stimulation device that creates a magnetic field that excites neurons and it's the other man's hand

15:33

begins to move and hits the targets so you've co-opted the portion of a body of

15:39

another human and then their hand can behave in the way that you wanted to do his goal you'll see later if you

15:45

download the video is he would like to have a cap that you could put on and have a surgeon direct your hands to do

15:51

battlefield surgery or something somewhere else in the world where they don't have a doctor who has the

15:56

technical skills you can put on the cap and your hands become an extension of that experts body they find motor skill

16:04

manipulation at that point in time was not great but the person on the receiving end described the sensation as

16:11

a rather odd said I didn't know anything until I saw my hand beginning to move and felt that it was something other and

16:18

it's hand was moving hand could punch in a code hand could do a number of things but the really fun part was that you're

16:24

taking over somebody else's physical body with the mind of another human so

16:30

what do you think would be the next step you follow medical research you say you can make a robot move you can make a

16:37

human hand move what would you do next

16:43

you say wow they're getting brains connected to run things and I have to

16:50

begin to think either like doctors or like you know security and intelligence people right can you actually send and

16:58

receive sensory information like the matrix I'll show you a little bit of

17:06

this experiment the short answer is yes

17:15

[Music] we were able to transmit brain-derived

17:20

information from one rat to another and basically got this pair of venomous

17:26

collaborating to solve tactile and motor tasks you know there's a behavior box

17:31

where the first animal is located and this animal is called the encoder because he's the one who does all the work he is

17:39

basically using his forepaws or his whiskers to perform either a model or a tactile discrimination task and while

17:46

he's doing that we are monitoring its behavior in recording the brain activity

17:51

that is being produced by this animal's brain and transmitting in real time all these electrical signals to a second

17:59

animal that is called the decoder while this animal has the lucky job of not having to do anything for getting a

18:06

reward the only thing it has to do is to receive this brain activity into its own

18:12

brain and then decode the pattern of information that the encoder has generated and indicate to us as through

18:20

behavior what it is that the first animal has discovered out there in the environment so if the decoder gets a

18:28

rate both animals get a nice juicy reward and that's what they want and

18:33

that's how they collaborate to actually get this job done here you see in the next slide encoder animal waiting for a

18:42

light stimulus that tells the animal which of two levers he has to press to

18:48

get a little bit of a water set and the light cells either pressed left or the

18:54

right lever so when the animal gets the light and is about to press the lever we

18:59

record the activity electrical activity from lots of cells in the motor cortex of this animal and instantaneously

19:06

transmit this information through the brain of a second animal that is in another box and cannot see the light and

19:13

cannot see what the first enemy is doing this is the decoder and he's receiving

19:18

this information through their tiny little pulses of electrical activity that are delivered

19:24

to the amount of this part of the brain that the encoder is using to solve the task so as the decoder gets this information

19:32

and basically decodes the brain pattern originated in the encoders brain it

19:39

responds to us behaviorally by pressing one or the other lever to tell us that

19:45

he got it right or not so it took some learning trials but not many took 75 between them to achieve an

19:52

accuracy rate of over 85 percent in just training their rats for a little while in the cages but this is a milestone

19:59

because it was not simply using the motor cortex to run a device this is actually having one animal learn

20:04

something and seeing and recording that activity and put it into the sensory

20:10

cortex of a second animal and that animal acquires the knowledge it is able

20:16

to act on the knowledge from the experience for something it has not ever done which is really fun when you think

20:24

about it would this facilitate language learning with this let you upload information when you don't know how to

20:29

operate a device does it serve well for covert communication this is done between two rats what we do know is that

20:36

DARPA did get permission for 500 operations to do deep brain electrode implants haven't published anything yet

20:44

but my guess is what you're looking at is human human thought transference and certainly in the open science world that

20:50

was published last month actually the brain to brain transfer of sensory information into humans they achieved a

20:57

success rate of being right 85% of the time so you can attach one human brain

21:02

to a device you can attach the human brain to another human brain you can

21:07

direct motor activity or you can send communication and information what we

21:12

know from the training trial data so far is that it probably requires it'll

21:18

probably require training trial between people as well and we don't know from an encryption and encoding standpoint

21:23

whether everybody's communication would follow the same patterns or not it may be that two people have to train and

21:29

then it's unique and then you have a yeah decryption problem for someone if they decide they can intercept the signal that would be but you could plug

21:36

in somewhere else in the world and learn something or see something or have somebody acquire the information that

21:42

you have and you wouldn't have to carry a different device so that's what people

21:48

are doing there's a whole world out there of biohacking I don't know if you're aware of it but you should be so

21:53

normally at the University we are well regulated by the federal laws about studying and experimenting on humans

22:00

there's a biohacking community that it's not part of the official science community that is busy trying to attach

22:06

hardware to humans and they do it in their basements they study up on how to do the surgeries how to connect devices

22:12

how to put motherboards in people and they may use it for some purposes like

22:18

fishing using RFID signals in their hands to take information from you but there are some other interesting

22:23

developments when you start thinking about the fluidity of what you can do with the brain they're experimenting

22:29

with ce6 and giving people with eye drops night vision for several hours a

22:35

person receiving the night jobs can see over 160 feet in the dark so it's a lot easier to look through your own eyes

22:41

than it is to put on nods and it will be a short time before you get a better solution then we get from the bio

22:47

hacking community but it could also be readily available to almost anybody on the planet it'd be hard it's going to be

22:53

harder to keep this under control than it is to keep the special lenses and night vision technology so I think it's

23:01

really important that people pay attention to do this kind of thing because that can give humans the natural ability for a while to see in the dark

23:10

the other new possibility coming along is that seeing in the dark is something

23:15

you don't really naturally do that well but with animals who've been able to achieve a number of other things one of

23:21

which is giving them an extra sensory ability if you will show you a short

23:27

clip people decided they wanted to know if they could give the rat an ability to do something it does not naturally have

23:36

recently researchers have given wraps an implant which allows the animal to obtain as they call it a sixth sense the

23:43

laboratory subjects were able to search and detect infrared lights which is an exceptional accomplishment given that

23:48

rats can normally see infrared lights a team at Duke University placed infrared

23:54

detectors which were wired up to tiny electrodes into the part of their brains that processes tangible information in a

24:00

source involved with the experiment Eric Thompson states this is the first paper in which I know a prosthetic device was

24:07

used to augment function literally enabling a normal animal to acquire a sixth sense researchers claimed that the

24:14

device could also help humans regain sight if placed in the appropriate part of the brain last year researchers used

24:20

a computer chip ridden prosthetic system to help transmit light signals in the brains of mice the minds behind the

24:27

study hope to move on to human trials using the retinal device to restore sight to those who had lost their vision

Sensory devices

24:33

so people are playing with chemicals to enhance the human capacity they're also experimenting now with how do you add a

24:39

device to the mammalian brain to give it an extra sensory ability you may not want to detect infrared you might want

24:45

to have a room temperature detector of radiation depending on what your job is

24:51

in life so when you think about it the possibility now is there to develop different kinds of devices they could be

24:58

perhaps used either by intelligence people or by people in the military to have an extra ability to be able to see

25:05

through walls to see heartbeats we used to play with the 18 gigahertz microwave

25:13

detectors where we could pick up heartbeats through anything but solid steel and water but that could easily be

25:18

a human who can see a unique heartbeat that's behind the wall over there that's thermal insensitive so it doesn't have

25:24

to be IR it can be a number of things anything that you can co-opt is theoretically now possible to adapt to

25:30

human brain functioning all you'd have to learn is the code you'd have to train with it it might not be natural at first

25:36

you might not understand the signal you're getting but you can add to human brain function also use it to intercept

25:43

signals the experiment that was just released this last month as I said

25:48

demonstrated that people could transfer knowledge from one human to another and I commented to a couple of my colleagues

25:55

and I said I think right now the most direct application of that is going to be either covert communication or

26:01

running drones the a set of experiments I didn't have videos to show you but there have been a

26:06

series that have shown you can connect the human brain to a rat and control its motor movement and its tail so you can

26:12

have non-human animal drones you can have the human brain probably run a

26:18

regular drone at this point but running a non-human drone something like a cockroach or a rat would it be awesome

26:25

and now the way if you were watching the Olympics and you see the coordinated maze of drones the software is now

26:31

really readily available where you could you could have hordes of little creatures that can gain access to

26:37

facilities or move around in different places all run by a person sitting in a

26:42

booth it wouldn't be it's no more technically challenging once you do that then figuring out the logistics of how

26:48

you're going to send your signal somewhere else in the world and how to protect that signal but that's that's

26:54

now that's not in the future so as you begin to think what's in five years the

27:00

interfaces are going to become more delicate more refined and as transcranial magnetic stimulation it's a

27:07

rather crude instrument right now it creates a feel that excites just hoards of neurons but as they as they refine

27:14

the technology so you can get a better point specificity to the neurons you actually want to activate you should be

27:21

able to do this without penetrating the skull either someone could wear a cap and in fact that's how the latest brain

27:27

to brain communication in humans was done it was done without surgery and actually signaling via some stimulation

27:34

to the retina and the brain decoding it although the person consciously didn't know what the code was the brain did so

CRISPR

27:41

that I would recommend people becoming aware of that from the human drone technology standpoint the second field that people

27:48

may or may not be aware of in I always tell my students I said it wasn't around when they developed atomic weapons but

27:55

dr. Venters work is my my view the equivalent of the development of nuclear

28:01

weapons when you realize that he created life in a cell back in 2010 I don't know

28:07

if people are familiar with his work but this technology paired with something called CRISPR which is like an editing

28:12

software for genes makes a number of things immediately available what he did is he

28:18

programmed yeast cells to produce anything he wanted they can produce perfume they can produce petroleum they

28:25

can produce any peptide anything we program the DNA to do and it's in the living cell right so in medicine the

28:32

goal in medicine now is to be able to do designer medicine and therapy if we can

28:39

design a cell to get into your body and release the right product for you you

28:44

won't be losing half the drugs you take through your liver when you swallow a pill and it gets digested these can be

28:51

inserted into you through the hypo spray needles almost like dr. McCoy on Star

28:56

Trek getting a hyper spray it just blasts no plasmids into your squamous cells but Venter was able to do that and

29:03

has the patent on the technology but you can engineer anything you can engineer a unique thing that would only kill one

29:08

person in the world it's how it's done you put in a specific gene slicing you

How it is done

29:14

program what you like you put it in the cell and it can reproduce and make as much as you like those of you who don't

29:21

know your DNA is usually all wrapped up in tight little coils and so what you were doing was when to create plasmids

29:27

and put them into cells it sends a signal and tells which portion of the DNA should unwrap unfold and produce a

29:33

product this is the future of Medicine when you look at this technology in medicine and say this is going to be

29:39

done to help people right we want to be able to give them medicine so we actually want to correct for genetic deficits if a kid's born with a genetic

29:46

anomaly with the CRISPR technology the feeling is we can create the portion of the gene they're missing and go have it

29:52

spliced back in and that may help a child either if it's in utero development or once they're older to

29:58

have the missing substance actively produced what would you do with this if

30:04

you were in security and intelligence well you can do a number of things you

High altitudes

30:11

could decide if you make this gene we know that certain people in the world who function that very high altitudes

30:18

very very well do it because they had a special mutation in their genome that we

30:24

don't have because we didn't grow up in the Himalayas but they can function at very high altitudes

30:29

could you give this to people who are going to have to do war fighting in high altitudes and they don't require extra

30:35

support their body makes them much more efficient use and can work under conditions of lower oxygen than the rest

30:42

of us you start letting your mind wander can it also produce a substance that lets you function longer underwater

30:49

without oxygen so but these are run by certain mutations in genes and with

30:55

CRISPR we have the ability to actually make these and see what happens when we give them to animals non-human or human

31:01

animals that don't have it naturally you

31:08

have the forest gump gene guys been tracking there's a gene that just makes you stronger I would say that most of

31:19

this technology is probably going to be employed by a state and not non-state actors because it's quite technical but

31:25

I say that with a caveat when we study the uma Shinrikyo if people remember they had both uranium mines and regular

31:33

laboratories where they experimented on both animals and had a whole series of

31:39

laboratory experiments to develop the different kinds of gases that they

31:44

wanted their goal was to actually mine uranium and probably come up with their own version of a nuclear weapon but they

31:50

recruited scientists PhD level folks and their goal was to be their rightful people running country of Japan but we

31:58

can't assume that just because they're non-state actors they will not make use of some technology around this related

Designer receptors

32:06

to this is an idea called dreads these are designer receptors that can be

32:13

remotely controlled so think about it for a moment you can create a designer

32:19

receptor you can create a cell you can put it somewhere in the body and you can

32:25

remotely activate it when the brain is exposed to the right signal using this

32:31

technology people have been able to transfer memories from one fruit fly to another by signaling through a light

32:37

stimulus into the retina right now in in animals it's done by putting a substance

32:43

into their body that will actually activate the neuron in the way that you want it so you have the capacity to

32:50

create any product as long as you know the DNA sequence you can insert it into a living system and you can remotely

32:57

control it so in medicine we think about how we do that to help people how we do to repair deficits other people are

33:04

going to think about how to leader to expand possibilities now one of the challenges that we have is that when you

33:10

create a cell and you put it in somebody's body you have to figure out where you want it what if you want it in

33:16

their brain right if you want it in their brain and you can't figure out you

33:22

don't want to do surgery to plant it in their brain if I want a product produced in your brain that may affect the way

33:29

you think the way you act one route to that is through stem cells you're a

33:36

quick brush up on your biology stem cells or cells there call them god cells they can turn into anything they hold

33:44

the potential unlike other cells in your body to become anything you want them to

33:49

become and they can go find their home in the body and park there and do the

Potential

33:54

work that you'd like them to do

34:02

you can infuse them and they will find their way into the brain so once you

34:08

know that the technology is there to edit splice and program a cell and the technology currently exists to

34:15

administer to somebody and have it go park anywhere you program it to go park proliferate and do its function you can

34:22

have things activated in other people's brains so you take these three key

34:30

points hopefully you can see it opens up a number of both alarming and exciting

34:36

possibilities you can have the time to

DNA encryption

34:41

release of information on demand hopefully when they mentioned the word CRISPR Edward editing and creating

34:47

molecules with CRISPR out of data and playing with DNA some of you thought encryption and encoding so DNA

34:55

encryption there were I think eight articles published by China in the course of three years in the last three

35:02

years and it's quite important the coding system DNA steganography I'll

35:08

just say short the short story on this is people have figured out how to hide imagery in the DNA of bacteria and when

35:15

you bus where s the bacteria you can discover the information or you can have the those are just to remind me you can

35:22

have the information reproduced in a string format as a form of a protein doctor Church up at Harvard has shown

35:30

quite well that you can store a lot of information in one gram of DNA it's

35:36

essentially yeah that many that many iPads in one gram at room temperature no

35:43

super cooling required DNA is highly stable spent around on the planet a very long time so between CRISPR the storage

35:50

capacity and programing cells the new way to hide information is going to be

35:56

in DNA the commercial application is going to be a bit like on Star Trek years ago why would you have a digital

36:02

system when you can have a DNA system can store all the information you'd ever need records photos anything it's simply

36:09

another way of storing information it had just been so slow up until five years ago it wouldn't be thought to be

36:16

practical but it is this is the first experiment showing what imagery you can hide in bacteria this is the latest it's

36:26

a gift file it was actually programmed into the DNA of bacteria last year

36:31

the bacteria reproduced and the offspring from the reproduction cycle would still produce this movie pretty

36:40

cool you can hide information in bacteria and when the bacteria multiply they can go into a spore form and last

36:47

for a very long time no one can scan you and find a bacteria

36:53

we don't have anything that can detect that well you don't so if you want to be able

36:59

to encode information take pictures of information create something in DNA and don't want it in your own body it can be

37:05

bacteria on some portion of your body right all they have to do is scrape it

37:11

let it grow in the petri dish and unpack the information this is all available now this isn't science fiction but you

37:19

can encode movies well this is what the

37:25

Chinese are doing with DNA so in your own neck of the woods you can begin

37:31

inquiry we are doing things with with DNA as well but the Chinese are fairly

37:36

convinced that DNA encryption encoding would be one tremendous challenge even for quantum computing so this is where

37:42

the race is right now trying to merge quantum computing with what you call a wet hard drive with DNA merging DNA

37:50

systems with quantum computing will be really quite an amazing and both lethal

37:56

threat for that

Memory

38:02

the next thing I wanted to mention to you is memory you play listen really

38:07

hopefully you'll recognize this hey

38:18

whoever you guys are you gonna have to show me some idea if you're gonna be in France hey whoever you guys are you

38:24

gonna propose hey whoever you guys are

38:31

the thing is gonna give a brain cancer or something whoever you guys are you so

38:42

what to do with memory in medicine we think of memory as a potentially harmful

38:47

thing when people present with post-traumatic stress disorder they can't stop thinking about the thing

38:52

that's creating emotional distress it's a very active development in the field to figure out can we erase memory can we

38:58

modify memory can we change memory coach short answer is yes several years ago

Can we change memory

39:07

with the PM zeta data out of Duke University this was the first time that

39:12

anyone had ever demonstrated that if you wash an area of the brain called the hippocampus it's an area of our brain

39:19

that's crucial for forming short memories spatial memories and then facilitating the transfer from a

39:25

short-term memory it's just something that's more permanent and stable over time that he could train the mice to run

39:31

the maze document the number of trials and errors and then flood their

39:36

hippocampus or expose it to this and the memory would be completely gone meaning

39:44

when the rats or the mice had to learn it over again it was the same number of learning trials now there was no trace

39:51

of the memory left now the good news for us when we study rats mice is we put

39:57

electrodes and cannulae into their brain and can directly affect that area of the brain if you wanted to poke your own

40:02

hippocampus you'd have to stick your finger through your eye and go right back in there sounds impossible to get to not if you program a cell to go there

40:13

so if you decide you wanted to program something that was selectively release PKM zeta after your meeting with someone

40:20

they probably would have no memory of it that's what's happening in the rats

The technical challenge

40:26

alright so the technical challenge right now is how do we get a cell in there to do that in human I can assure you

40:33

they're working on that in non-human primates right now how many what's the point specificity can we get it in there

40:39

close enough to the hippocampus will those cells start reproducing in the next day make enough of that stuff to

40:45

wipe out a memory related to this once

40:53

you start thinking about memory are chemicals that not only wipe out memory the chemicals that enhance it so if you

41:01

want a better human camera a better an individual who can just go see and

41:06

remember everything that's the direction that the research in this Lane is taking

41:12

to help people with Alzheimer's how to give them memory back so what's being actively studied are the few people on

41:19

the planet who have hyper monisha others they remember everything that's ever happened to them we're actively trying

41:25

to understand how to unlock that and unpack that and figure out why it is their memory does seem to record and

41:31

they retain everything they've seen they don't find it Pleasant and medicine

41:36

would like to people in medicine want to try and understand that so they can turn it into something beneficial for people who are losing memory from a security

41:43

and intelligence standpoint it is a really unique opportunity to begin to

41:49

discover can you administer a drug that enhances human memory for a certain number of hours does it have to be

41:55

permanent so rather than carrying technical toys somewhere to try and

42:01

record and collect information your brain just remembers it which doesn't

42:06

give anybody anything really to detect that's one potential use for it and that

42:11

is one lane of research that's going on I was just my picture to remind me that

42:16

the man who knew too much if you remember the old Hitchcock film essentially that's what he'd done remembers memorize all the steps on how

42:23

to make a bomb he'd remembered the codes even hurt everything that research on hyper

42:29

memory has gone more slowly than I thought in 2010 I thought by about 2015 there

42:36

would be some progress there hasn't been much yet in expanding memory very much it seems to be a harder nut to crack

42:42

than erasing memory erasing memory seems to be far easier the last topic I wanted

42:48

to review with you is memory I don't know if you recognize any of the imagery

42:53

up there but I'll walk you through it with memory in the last five years

42:59

what's been demonstrated is that you can train a fruit fly around an aversive

43:04

experience and you can transfer that memory to the brain of another fruit fly by manipulating the rods and it gives it

43:12

a memory for something that it's never had before and then it reacts to the stimulus in the same way as the animal

43:18

who did have the aversive learning experience it's been done in mice I'll talk a little bit about Beth Loftus and

43:24

I have done two men and women going through severe school and changing memory and I put the last slide up because this

43:30

is in flatworms and this came out two years ago that memory really is something beyond what we typically

43:36

understand in flatworms you can cut their head off and their body still remembers stuff so they're just

43:43

beginning to uncover or decode where and how memory stored in the body of this

43:49

little creature so we can translate that into memory in animals that look

43:56

different than that little creature it's evolved it for a very interesting reason so this is the in 2009 using light

44:02

they've transferred the transferred memory you can turn things on and off using light in animals to activate the

44:10

hippocampus turn memory on and off and so where are we with humans in creating

44:15

false memories giving the memories that they've never had we've come a long way my colleague is Beth Loftus and this was

44:21

her early work it was called lost in a mall and what she did is she asked a person to be in the study

44:26

you could be in her study if you had a sibling that was at least five years older than you and she'd say we're interested in your memory from when you

44:32

were a kid I've asked your older sibling your older brother or sister to give me four stories about you and I want to

44:38

know how much you remember what people didn't know is that there were four different stories one of them

44:45

was fake and she wanted to see how long it would take for them to adopt a false memory the quick answer is after to

44:52

interview sessions 30% of the subjects believed that they remembered the person who'd found them when they were lost at

44:58

a mall and actually argued with the researcher about whether or not the memory was true or not

45:03

and that's how I met her we decided to get together and run up to Brunswick to see her school and try a memory

45:08

experiment this is our design if you're not familiar with sere there's a classroom phase there's an experiential

45:15

phase we were interested in sampling people when they were in isolation when

45:20

they're returning their gear and at the end and we tried a couple of different techniques group one

45:26

there's no misinformation we simply want to sample accuracy of human memory for their experience and we told them at the

45:32

beginning is here we want you to be the best little human collector possible we are going to quiz you about your memory

45:37

don't let us trick you we want to know what you remember group two we told them the same thing but we lied when they

45:44

took their questionnaire at the end we incorporated several techniques from false memory techniques which are a

45:49

little bit of leading questions to see whether or not we could create false memories in the third group we exposed

45:54

them to an erroneous photograph of their interrogator and in Group three we used the group four we used a video so here's

46:02

what we did by exposing them to a photograph after they had been interrogated and placed in isolation

46:09

stress it could change them from this guy to this guy 48 hours later on who

46:15

they were identifying the lineup their level of confidence was an 8 out of 10 that that was the person they had met we

False memories

46:24

found that we could make them believe that there were guns that there were knives that there were caches of weapons simply by altering the phrasing of a

46:31

question or inserting something into a video I'll give you an example if we said did your interrogator wear a weapon

46:37

if so please describe it we only got about a 2% endorsement of the presence of a weapon in the in the interrogation

46:44

phase if we said when you were being

46:49

interrogated by your interrogator and the guy with the weapon in the interrogation what did they argue about we didn't care what the answer was

46:57

we'd ask another question they described the weapon worn by your interrogator it jumped to 30% would tell us the type of

47:04

firearm that they had seen in the interrogation booth there's a security violation right there there weren't any

47:09

we've got to record them but with one question we could do that when you sample with a few more you can actually

47:15

increase the sample so when we increase the stress that's here we found that

47:20

instead of a 30% rate overall we could create false memories in nearly everyone that was in 900 people yeah so Beth and

47:28

I were talking about that we said well you can change memory we know that it's a way of understanding maybe why and how

47:35

people have recovered memories of abuse that never happened that's what her work has mainly been about so she decided to

47:42

do a study called licked by Pluto she just said she couldn't make Mickey Mouse a sex offender but in her lab they

47:48

thought Pluto was fair game the short story is people got to they were exposed to some misinformation about a man who

47:54

addressed in the Pluto outfit at Disney and he'd been inappropriately rubbing his large fabric tongue on children

48:00

pleasurably and not pleasurably there were two different conditions then there was a neutral condition if people

48:07

adopted the false memory and their memory was for something negative they did not want to buy the Pluto toy all

48:14

right when they went down their list what they would not buy she's done it with food that was from her series with

48:21

Alan Alda she gave him a false memory that he'd been sick one time eating deviled eggs and here they offer him one at the

48:28

picnic on film and you get the classic disgust wrinkle and he said now I got sick one time eating them it's not a

48:33

true memory it was planted she's done it now with strawberries and ice cream also done it with pickles and has done it

48:40

with alcohol study last year was that if you give college students the false memory that they were terribly hungover

48:47

they had a wicked hangover from drinking too much tequila then when they're given free range options at the bar like a

48:53

week later they decline it at twice the rate of everybody else they got them now got sick doing that so think about it if

49:00

you change the past you change human behavior we are a case based reasoning

49:06

animal when we think about what we're going to do we think about the last time we did something or the what we heard about or

49:12

what we think it would have done so to change human motivation we don't have to persuade people you can just change

49:20

their memory think about the defensive

Changing human motivation

49:29

and offensive capabilities of that if you think about this from a defensive

49:34

standpoint you have the ability to change the memory of a person has been debriefed in a safe house about the

49:41

identities of who they met the layout as we've looked at altering memory for for

49:47

plans for faces for timing if they're wrapped up by their intelligence service

49:53

they don't have anything to lie about or what they remember is actually genuine but it's wrong that might be a defensive

50:00

way of applying the technique in medicine people are arguing about whether or not you can use false

50:08

memories to help people can I give you a false memory that leads you to stop smoking or is it unethical because I

50:14

can't tell you I gave you a false memory I'd have to do it outside of your permission for your good most of the

50:21

things probably unethical in this society than we think you probably should be an informed consumer but it's

50:27

a possibility that you can do and when I think about this I think about its

50:32

relevance in this day and age when you start wondering what information is real and what information is trustworthy and

50:40

you start running into people and debriefing them and you have sources who claim things when you can learn how to

50:45

create false memories a person can be genuine and the information they remember is it is a

50:50

little dangle idea you can put information out that it's simply not true but in the current social media age the

50:57

ability to actually manage people's memories and change them it's just enhanced compared to what it used to be

51:04

now you can you can fix the videos and pictures and expose people to audio and

51:09

visual information and we know that even if they know that's a possibility people don't recognize when they adopt a false

51:15

memory so it's a bit of a Trojan horse effect you don't know that it's happened to you if you're smart and you have a good

51:21

memory you believe that happens to other people but not you because your memory is true so it bypasses some critical

51:27

reasoning on our part and I think it's particularly it's particularly effective

51:32

that's where the state of the art is right now for creating false memories in humans is doing that verbally or by

51:40

these manipulations with either what we say what we show them what we expose them to but the chemical implanting of

51:48

memories has now occurred in monkeys so in trying to restore memory there is

51:53

probably I would say in the next two years we should see the science experiment come out that says a memory

51:59

has actually been transferred or created and planted back into a human brain that wasn't done by a classic false memory

52:05

technique but I would anticipate that that's the direction the research is going how do you rebuild memories and

52:11

people have had a TBI active research is going on about that on nanite

52:16

reconstruction of brain brain cells and and brain networks and the idea in the

52:21

mental health community is people lost part of their brain we want to restore memory and brain function can we put the

52:27

memories back in so it's it's probably only science fiction for another two years given given the state of the art

52:34

and the progress around that and then and the last thing I'll say I didn't

52:39

have any videos for it I really wanted to show you one but the French have published a very interesting paper and

52:46

it is this well people were sleeping they were able to train them and sample

52:54

their knowledge and what they trained him in while they were asleep and while

52:59

they were later awake and didn't know that they'd learned the information so

53:06

I'll say it again in people who were asleep they were able to tell what

53:11

people knew around word recognition lists without ever waking the person up

53:17

they were also able to train new memory and information outside the person's

53:24

awareness while they were asleep where that technology can go is some

53:32

very interesting places it would really raise since I was in the lane of DMT and we talked about deception and everybody

53:38

is arguing about how to interrogate people it raises an immediate question about whether or not you can sample information in people's brains outside

53:46

of their awareness the problem with a cat scan and the PET scan any technologies you have to have a willing subject they do need to sit still if

53:55

people are asleep and you can begin to sample what their brain recognizes it offers a number of opportunities that looking at guilty knowledge brain

54:02

recognition waveforms and sampling some kinds of information I don't know how

54:09

soon it would be when you can link someone's brain to somebody else's while

54:14

they're asleep but I would imagine that that can't be far off I'd probably ballpark it and say

54:19

probably five years if they have to do the brain implants we'll know sooner

54:25

because I I can't see any other reason why DARPA got approval for five hundred deeply deep brain implants I think the

54:31

next step is going to be a hive a hive brain that's already been done in rats you can link multiple brains and as a

54:38

hive they solve problems much faster than the individual rat so that technology's here I'm assuming the link

54:45

people who they've given permission who've given permission to link their brains to have a productive life live in

54:51

virtual reality move robotic things they can probably some problem solve so I think in the next years that's what

54:57

we'll see is bring to bring linking for problem solving but to see if it makes it more efficient but those are a couple

55:03

of technologies that one make you aware of and then you can run away and think about their more direct applications I

55:09

tend to think of things from a medical perspective and from an intelligence and information perspective but it's no

55:14

longer really science fiction and most of these fields have moved faster than I actually thought in 2010 the only one

55:22

has been expanding memory that hasn't hasn't moved as fast but I thought they would share that with you and that's all

55:27

I had to say thank you for your time yeah [Applause]

55:35

all right Thank You dr. Morgan we're pretty much out of time but we'll be hanging out up here for a little bit so

55:40

if anybody has questions feel free to come up and thank you for coming out